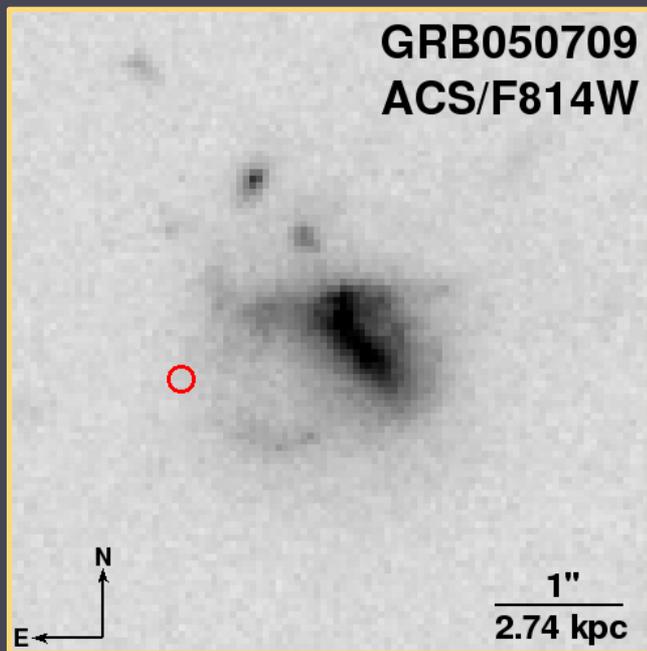


Observations of Short GRB Host Galaxies: Morphologies, Offsets and Environments



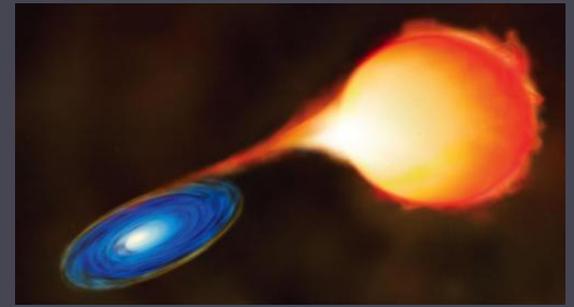
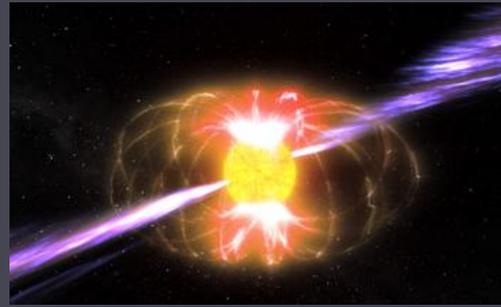
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Fong, W., Berger, E., Fox, D.B., ApJ, 708: 9

Motivation: What are the progenitors of short GRBs?

- ◉ Constrain short GRB progenitors through studying their local and galactic environments
 - Morphology
 - Host-normalized and physical offsets
 - Host light distribution
 - Comparison to long GRBs (offsets follow massive stars in an exponential disk; track the brightest UV regions)

How do our methods constrain popular progenitor models?



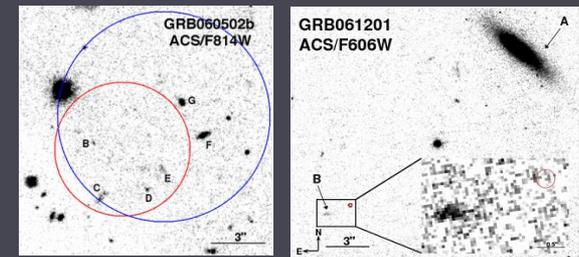
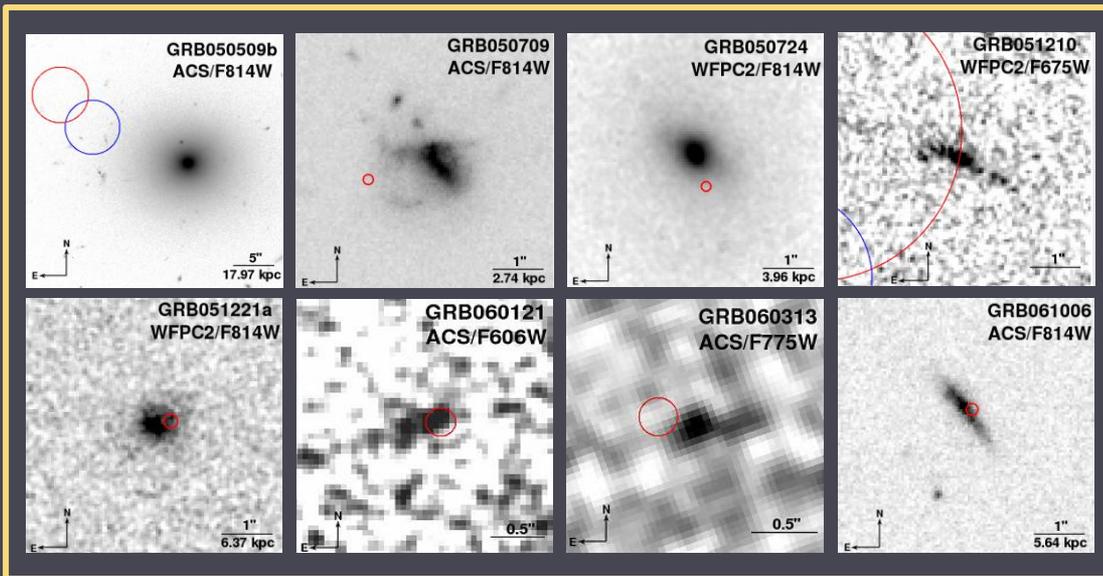
NS-NS merger / NS-BH merger	Magnetars	WD-AIC / WD-WD merger
<ul style="list-style-type: none">• Large physical offsets (kicks)• No correlation with host's UV light• Possible correlation with host's optical light (if not completely kicked out)	<ul style="list-style-type: none">• Similar offsets and light distribution to long GRBs or core-collapse SNe	<ul style="list-style-type: none">• No kicks• No correlation with host's UV light• Correlation with host's optical light

Sample

10 short GRBs with *HST* data, 2005-2006

- 7 with optical afterglows
- 5 with redshifts

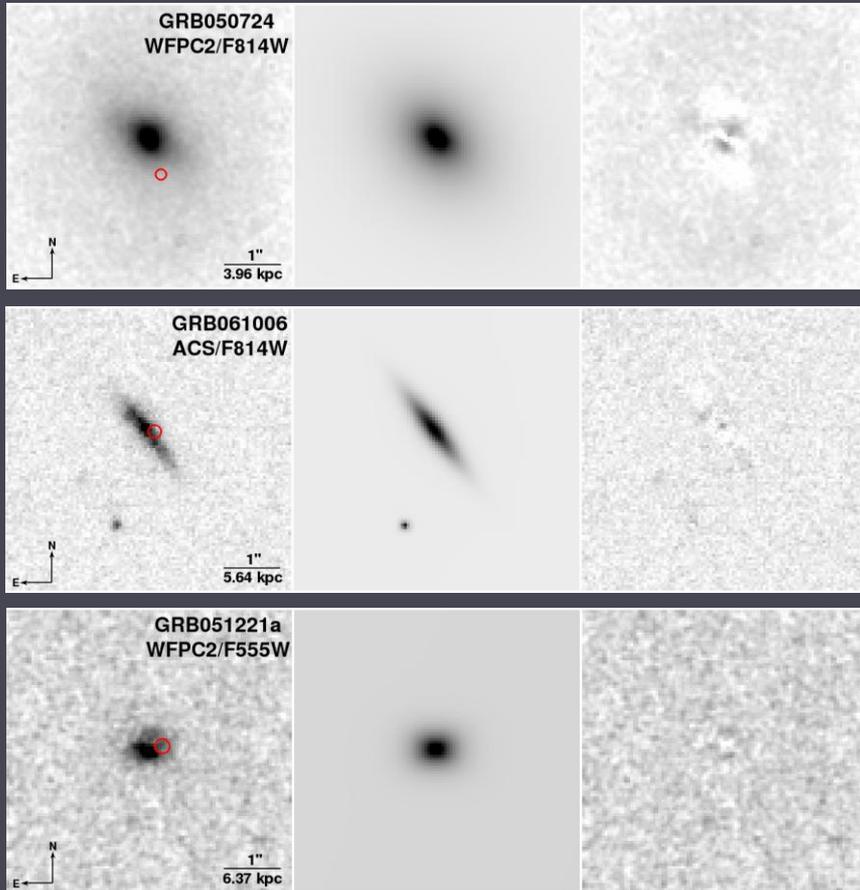
8 with hosts



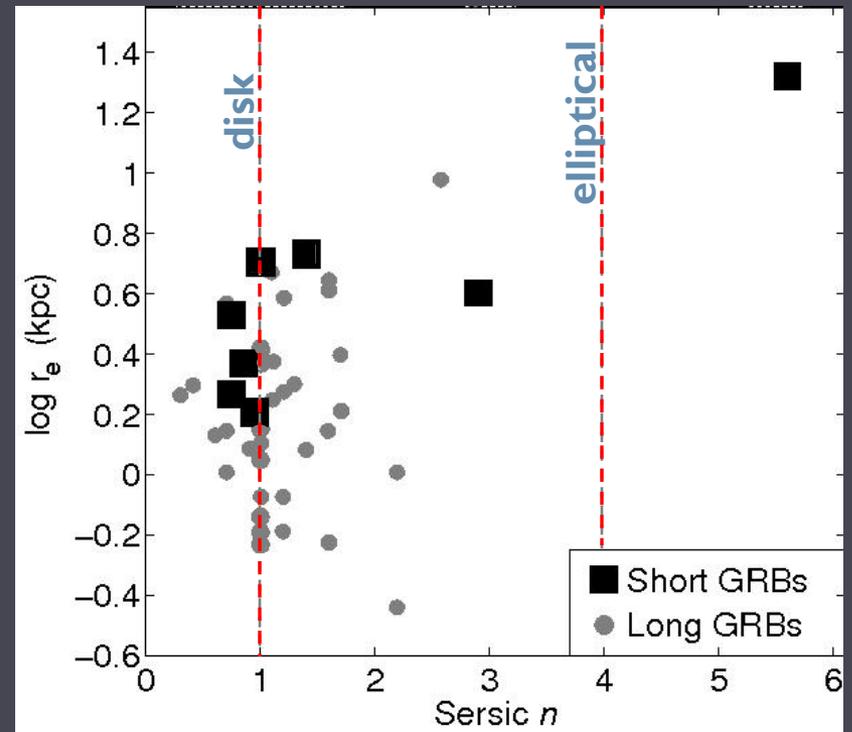
Fong, Berger & Fox 2010

Short GRBs are found in all types of galaxies, but prefer disks

Fong, Berger & Fox, 2010



- 6/8 short GRB hosts have disk profiles

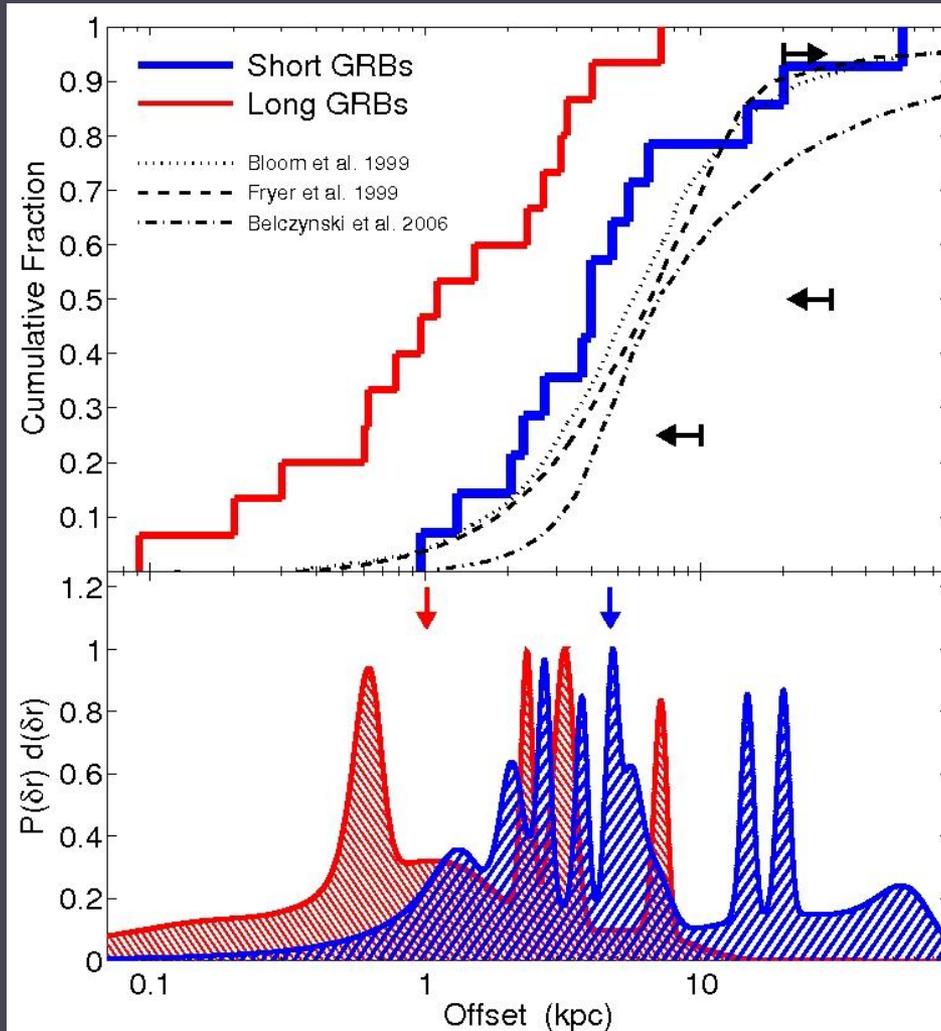


- Are ~ 2 times larger than long GRB hosts

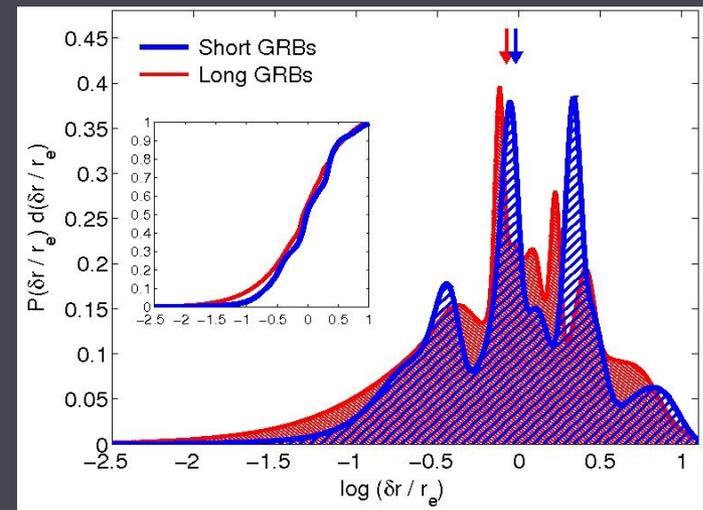
Short GRBs offsets compared to models and long GRBs

Fong, Berger & Fox, 2010

Long GRBs from Bloom et al. 2002

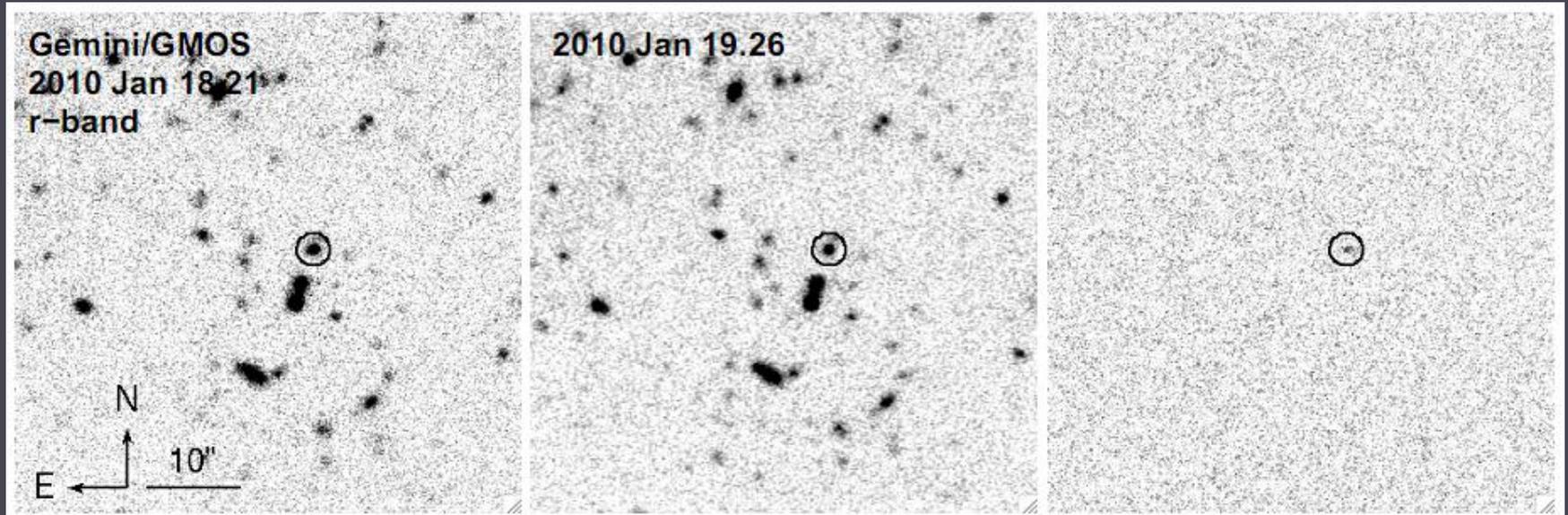


- Short GRBs have significantly larger offsets than long GRBs
- Physical offsets consistent with NS-NS merger progenitor



Host-normalized offsets?

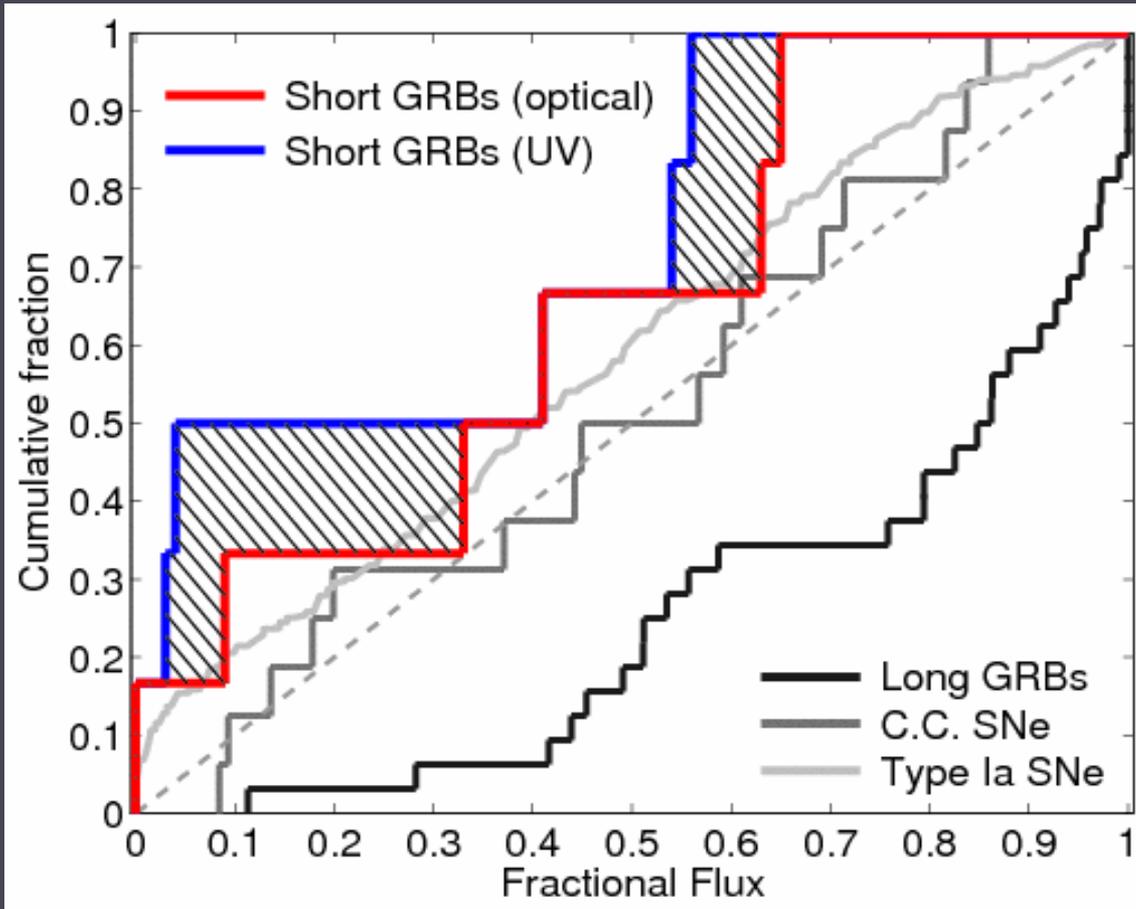
Interesting non-HST case: GRB 100117A



Fong et al. 2010b (in prep)

- 2nd early-type host association with an OA
- Smallest physical short GRB-host offset to date of ~ 0.5 kpc
- Are the offsets in elliptical hosts smaller? (050724, 100117)

Host light distribution



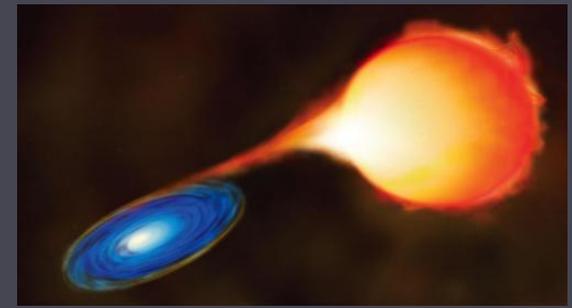
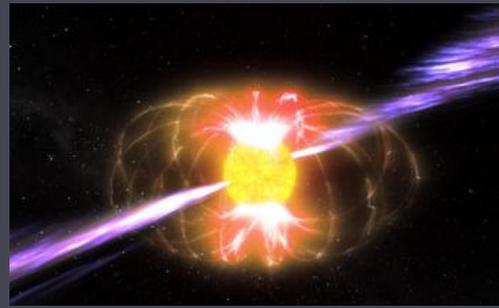
Short GRBs under-represent the UV light and marginally track the optical light, indicative of a progenitor from an older stellar population

Fong, Berger & Fox, 2010

Long GRBs and cc SNe - Fruchter et al. 2006

Type Ia SNe - Kelly et al. 2008

Using results to constrain progenitor model predictions



NS-NS merger / NS-BH merger	Magnetars	WD-AIC / WD-WD merger
<ul style="list-style-type: none">✓ Large physical offsets (kicks)✓ No correlation with host's UV light✓ Possible correlation with host's optical light (if not completely kicked out)	<p>✗ Similar offsets and light distribution to long GRBs or core-collapse SNe</p>	<ul style="list-style-type: none">✗ No kicks✓ No correlation with host's UV light✓ Correlation with host's optical light

Consistent with NS-NS, partial contribution from WD-AIC, magnetars do not contribute significantly.

Conclusions

- **Progenitors**
 - **Consistent with NS-NS/NS-BH merger**
 - **Possible partial contribution from WD-WD merger / WD-AIC**
 - **Magnetars do not contribute significantly**
- **Morphology**
 - Mostly late-type
 - Larger than long GRB hosts
- **Offsets**
 - Physical offsets are $\sim 5\times$ larger than long GRB offsets
 - Preliminary host-normalized offsets very similar to long GRBs
- **Host light distribution**
 - Do not track their hosts' UV light, trace optical marginally well
 - Suggests an older progenitor population